Vol. 13(21), pp. 704-711, 10 November, 2018
DOI: 10.5897/ERR2018.3609
Article Number: F4E729F59251
ISSN: 1990-3839
Copyright ©2018
Author(s) retain the copyright of this article
http://www.academicjournals.org/ERR

ACADEMIC JOURNALS
expand your knowledge

Educational Research and Reviews

Full Length Research Paper

Use of technology in constructivist approach

Ayse Derya Isik

Department of Primary Education, Faculty of Education, Bartin University, Turkey.

Received 10 September, 2018; Accepted 30 October, 2018

Over the course of history, the structures of societies have changed at certain periods depending on technological and scientific developments. In today's societies, such mental processes as information processing and production have become prominent and the educational systems are revised according to the constructivist approach, which focuses on mind and is based on developing cognitive skills. Technological tools have a significant place in ensuring active learning. These tools contribute to the educational system in general, to students, teachers and the entire process. In this study, the use of technology in the constructivist approach in an educational environment is discussed based on scientific research. The result of the study revealed that constructivist approach supported the educational environments in terms of activating prior learning, sensitivity to individual differences, accessing the sources of information, forming experiences, supporting individual learning, supporting lifelong learning. Also included ae: supporting learning when required, supporting collaborative learning, enabling process evaluation, communication, ensuring active learning, enabling interaction, providing guidance, providing flexibility in curriculum, supporting the use of high-order cognitive skills, supporting skills development, arranging learning environments, supporting activity-based learning, and supporting the construction of a positive attitude towards learning.

Key words: Constructivism, technological tools, educational environment, benefits, restrictions.

INTRODUCTION

Technology is defined as "the tools that human beings develop to control and change their material environment and the knowledge of all relevant things" (TDK, 2018). Behaviors towards controlling and changing the environment started with the existence of human beings. When humans do not have the power, they use their mind to design and develop tools for their use. The same skill has been used in learning-instruction environment and various tools have been developed for use in these environments.

The industry, which was the indicator of the power of societies in the past, created a structure based on production, using existing knowledge. As in master-apprentice relationship, the education systems during the time focused on knowing existing information and using the tools. During the time, when the behaviorist approach was practiced, people's behaviors were changed and assessed. Educational environments, tools used in these environments and activities were organized to serve this aim.

Scientific and technological developments later led to changes in the social structure. Information has become

E-mail: aysederyaisik@gmail.com.

Author(s) agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

www.manaraa.com

the most important factor determining the power of societies. Those societies that produce information have a voice in the world. Producing and processing information take the center stage as important values. Existing information rapidly increase and such bulk of information increased the learning capacity of people. Educational systems that took the function of instruction failed to teach the bulk of information. In addition, the concept of learning changed. Although having knowledge on many fields including history, science, geography, arithmetic calculation, and writing foreign language skills were regarded important for years, it was understood that this knowledge and skills did not guarantee comprehension of the subject area (Perkins, 1993).

It is seen that in a period in which such cognitive processes as processing and producing information have become prominent, using an approach that focus on human behavior will not provide expected results. Therefore, first the philosophy of education changed. Education is comprehended as an objective in using knowledge and skills actively (Perkins, 1992). In addition, it is believed that an educational philosophy, that is the constructivist approach, which focuses on the mind of people, with the aim to improve cognitive skills, claims that "information is formed as a result of one's interaction with his environment (Bagci, 2001)". This philosophy is believed to meet the requirements of today.

Constructivist approach

Constructivism is an approach that takes a role in developing instruction methods based on the construction of knowledge by an individual, based on his/her prior knowledge, skills and competences.

Balkan Kiyici (2003) claims that constructivism approach is a model which arose with the idea of making education more efficient and lasting; and one that uses the existing instructional strategies but gives a new direction to them. In constructivism, learning occurs with the active efforts of the individual and constructed in one's mind (Gunes, 2013).

Turgut et al. (1997) summarize the main principles of constructivist approach as follows:

(1) Information is appropriated to the mind and called assimilation; information perceived does not conflict with the existing prior knowledge of the individual and is incorporated in existing categories in one's mind.
(2) It creates an imbalance in mind if the perceived information does not fit any categories in mind. In order to incorporate this imbalance, learners use a set of cognitive processes. Moreover, this restructuring process is called accommodation, while the procedure of restructuring is called self-adjustment. The process of incorporating imbalance is affected by one's prior knowledge and cognitive skills. If one of these falls short, self-adjustment process fails and unaccommodated behaviors of the individual continues to exist.
(3) People can experience this imbalance without receiving information from the external world and by asking questions themselves. In such a case, such creativities, as producing original information and finding an original method, are formed.

Teachers adopting constructivist approach tend to use educational technologies more frequently in their classes and try to include their students more in the process of teaching (Niederhauser and Stoddart, 2001; Coppola, 2004; Ertmer, 2005; Baser and Mutlu, 2011).

METHODOLOGY

This review article starts with presenting an overview of constructivism and technology concepts which are based on scientific works, then goes on to how and why technological tools are used to support constructivist approach. Key issues related to the relationship of constructivism and technology were identified through reviews of the literature on constructivist approach and the literature on the technological tool used in the education environment.

RESULTS

Continuously, reforms are made in the concept of education and educational systems in order to educate individuals who research, access information, question, relate, discuss and construct new information and to meet the requirements of the society. With the adoption of constructivist approach, the curriculums and course books have changed and through in-service trainings, teachers have been informed on the issues of guiding the learning process and how they will plan and implement activities in the classroom such as assessment and evaluation activities. Technological tools are also used in educational environments. Yilmaz and Naci (2017) advocate that the constructivist learning theory applied in Turkey last year, used information technologies as imperative for the development and implementation of teaching programs. In addition to all these changes, the ways tools are used have also changed.

In the current study in which the conveniences of using technological tools in learning environments could bring to the implementation of constructivist approach was discussed, it was found that technological tools could support constructivist approach by activating individual's prior learning. It could also support sensitivity to individual differences, accessing the sources of information, forming experiences, supporting individual learning, supporting lifelong learning, supporting learning when required, supporting collaborative learning, enabling process evaluation, and communication. Ensuring active

www.manaraa.com

learning, enabling interaction, providing guidance, providing flexibility in curriculum, supporting the use of high-order cognitive skills, supporting skills development, arranging learning environments, supporting activity-based learning and supporting the construction of a positive attitude towards learning are also included.

DISCUSSION

Here, the benefits of supporting constructivist educational environments with technology are discussed in the light of the studies in the literature.

Creating a learning environment that is convenient for the constructivist approach is the responsibility of the teachers. Using their skills and knowledge, teachers try to provide students with an environment where students will show their prior knowledge, find out new information, make sense of the new information and derive results. During these steps, technological tools are the most important supporters of teachers. Technological tools have a significant place in ensuring active learning. These tools contribute to the educational system in general, to students, teachers and the entire process.

Over the last twenty years, technology has reorganized how we live, how we communicate, and how we teach (Siemens, 2005). The use of technological tools in educational environments makes these environments advantageous in terms of making it easier to access the sources of information and supports individual learning, lifelong learning, environmental learning and learning in times of need. Also, such tools encourage learning sensitive to individual differences; ensure the transfer of situations that cannot be formed via simulations in learning environments to these environments; create exact learning environment; support learnings convenient for the readiness of students; encourage learning by fun via educational games and providing opportunity to develop different skills (Isik, 2014). The use of teaching materials and materials in education provides students with more active participation in the lessons, giving them the opportunity to learn by doing and experiencing, providing more attention to the wishes, ideas and needs of the students in education. It also enrich the educational process by supporting teaching, facilitating learning by providing concreteness in the perception of information, reducing disremembering, encouraging the student, achieves by making-living and naturalizes the learning environment (Çelikkaya, 2017).

Kilic et al. (2003), who claim that technology takes the role of transferring information or, in other words, the role of the teacher in traditional methods, believe that learners use technology-supported constructivist environments to analyze the world, to access information, to interpret and organize their own knowledge and to share it with others. Using technological tools in learning environments will provide certain benefits in the implementation of the constructivist approach.

Activating prior learning

Gunes (2014a) indicates that the first step in constructivist educational environments is activating prior learning. Watching a video, listening to a voice record or an image at the beginning of the lesson will provide the environment in which students' prior learnings will be activated. The teacher will be able to control whether the prior knowledge is true and will correct if it is wrong. If the student does not have prior knowledge, the teacher will provide the opportunity for the formation of this prior knowledge by additional activities.

Sensitivity to individual differences

There are individual differences among the students in the classroom. Some students need to make more exercise and repetition to learn compared to others. If the teacher arranges the learning activities, these students will not only bore the teacher because of their human nature but also those students who learn faster. In addition, those students who learn slower will be psychologically disturbed. Moreover, in an exact opposite case, the students who learn slower will not understand the subjects. Computers will enable students make as many repetitions and exercises as they want without insulting them and will help them to learn and feel psychologically easy. Besides, computer will score students' answers faster than the teacher will and will instantly correct mistakes with instant feedbacks. Students are ensured to see the correct answer when they make a mistake via instant feedbacks and to access the information on the subject. It is claimed that because technology supported constructivist approach makes it easier to get to know the students, it will enable an education that takes individual differences into account (Kaleci, 2013; Ciglik and Bayrak, 2015).

Accessing the sources of information

Technological tools make it easy to access the sources of information. Students have the opportunity to access information over the internet or the information they store in their storage tools at any place and time. Accessing this information when they need provides a ground for more permanent learning. In addition, during reviews in order to find the certain information they will come across different information and learn the ones that attract their attention.

Technological tools are highly important in interpreting

www.manaraa.com

information using the prior knowledge and thus, constructing new information step of the constructivist approach, which forms the ground of this approach. Technological tools provide great convenience while remembering prior knowledge, compensating gaps, accessing new information, obtaining additional information required during comprehending this information. In this respect, they contribute to the formation of educational environments convenient for the constructivist approach.

Forming experiences

Taking the fact that it is real-life situations where learning occurs best, technology-supported constructivist learning environments should offer real-life situations for learners to construct information. Situations, which are not possible to include in learning environments, are transferred to the learning environment via simulations. This will provide the basis for students to learn by experience and thus, learn permanently. Among the reasons for using simulations in learning environments are its effect on learning, the opportunity it offers to bring cases that are not possible to create the learning environment with less difficulty and enabling students to experience the situations in a safe environment (Isik, 2010). The advantage of reflecting events that are time-consuming, dangerous and impossible to observe in real life should be certainly utilized (Kilic et al., 2003).

Supporting individual learning

In individual teaching, students sit before the computer and learn everything on the computer. This enables individual learning. However, constant use without supporting it with any other types of learning will have negative effects on students' socialization.

Supporting lifelong learning

As a requirement of the information society, the process of obtaining and processing information expands to all areas of life; and with the rapid development of technology, on the other hand, there are rapid changes and developments in daily life. Those individuals who successfully adapt to these developments become the ones demanded in business life while others lose their qualifications. In this respect, learning has become a lifelong activity. Technological tools help individuals in terms of accessing the sources of information and providing them with learning activities. In addition, they also support adult education by providing flexibility in time and place.

Supporting learning when required

In order to ensure efficient learning, it is necessary to relate the information to be learned with daily life. Individuals, adults, in particular, are more positive towards learning information that they will use in daily life. Learning especially the information that is required for the solution of a problem experienced is easier. Technological tools provide individuals with the opportunity to access and use the information they need when they need it and thus, to learn it by providing access without any time and place limitations.

Supporting collaborative learning

In their study, Yavuz Konakman et al. (2013) found that prospective teachers see constructivist education environments as environments supporting cooperative work. Since the internet makes it easy to access experts and learners, which is something that is not possible geographically, cooperating with others and discussing the ideas created, which is something that constructivist approach supports, is possible. In addition, various software supported by technological tools are used in sharing information with other people (Tezci and Gurol, 2001). Technological tools enable individuals that work in cooperation with each other to share the materials and files they created without any limitations in time and place. Besides, the existence of software that provides the opportunity to work on the same file at the same time support collaborative learning. Unal and Cakir (2016) investigated the effect of constructivist learning environment supported by cooperative technologies on academic achievement. According to the results of the study, it was found that the students had high academic interests throughout the application. Moreover, it was found that most of the students were satisfied with such an implementation process. On the other hand, according to the results of the interviews with the students, it was found that the constructivist-learning environment supported by collaborative technologies contributed to collaborative work skills, contributing to permanent learning, problem-solving skills, occupational and planned working skills.

Enabling process evaluation

In constructivist approach, evaluation does not only cover learning outputs as in traditional methods but the process of learning and student's self-assessment. Technology also offers many advantages in the evaluation. Technological means are used in recording student's information constructing process and storing the information they reached and the conversations in

www.manaraa.com

discussion environments (Tezci and Gurol, 2001; Kilic et al., 2003; Isik, 2010).

Communication

Another main element of the constructivist approach is social learning. Individuals are social beings and they learn by interacting with their environment. Using technology provides ease in ensuring communication. The internet provides the opportunity for people from all around the world to communicate. In addition, with different programs, people can communicate orally, visually or in writing either synchronously or asynchronously. It enables the student to communicate with their classmates or teachers outside the classroom as well as with anyone from anywhere around the world. Thus, accessing primary sources and experts can be supported. Gilakjani et al. (2013) argue that "another positive and desirable effect of bringing technology into the classroom is the increase in collaboration among teachers and students". Thus, students will be able to benefit more from the guidance of their teachers.

Ensuring active learning

Ciglik and Bayrak (2015) claim that through using the constructivist approach in distance education system, all technology, materials and people in the process of learning could prioritize students. By using technology cleverly, teachers can make their classes more interesting, student-centered and dynamic (Becker and Ravitz, 2001; Judson, 2006). In the constructivist approach, the aim is to make individuals, not the ones instructed but individuals who learn. By using technological tools, individuals can access information individually, construct new information and produce new things by using this information. Thus, they can actively take part in the process of learning.

Enabling interaction

Technology-supported learning environments enable an interactive medium for learners. Learners are able to share their ideas, discuss with others and change if they have any wrong ideas. In interactive environments, there are connections for learners to reach raw and scientific information. In this respect, enabling interaction provides learners the opportunity to guide their own learning. By enabling interaction, more efficient learning is ensured (Koile and Singer, 2006).

Providing guidance

The constructivist approach enables learners to guide their own learning and in addition to that, it requires teachers not to be instructors but guides for learners. In order for teachers to act as guides for learners, they should know the learners with all their individual characteristics, as well as follow and monitor them individually during the activities. Depending on the number of students in each classroom, this is mostly not possible to do. However, with the use of technology providing guidance becomes easier. In some cases, computers take the guidance responsibility. Interactive software, in particular, show high performance in guiding individuals. In addition, such software provides the opportunity for teachers to examine the process of the activity in detail by recording these activities, to assess students' individual progress and give learners new responsibilities depending on their performance.

Providing flexibility in curriculum

In the classical way, curriculums show which information will be delivered at which periods, as well as the activities and methods, will be used. However, in constructivist approach individuals should manage their own learning. With the use of technological tools for learning, individual is able to manage his/her learning in line with his/her knowledge and skills. The learner is able to reveal his/her own prior knowledge, learn incomplete knowledge, Access raw information, learn at his/her own pace, decide on the content according to his/her interests and produce unique information at the end of the process. Utilization of such portable devices as mobile phones, laptops and palmtops, smart phones and tablets provides freedom of movement and m-learning (Adar and Kandemir, 2008). Thus, learning could happen anywhere and anytime.

Supporting the use of high-order cognitive skills

Moersch (1999) indicates that by using technology properly, it is possible to support the development of higher-order cognitive skills and complex thinking skills. Information society forces individuals to access information, process this information and construct new information. In this respect, it is necessary for individuals to use high-order cognitive skills actively in order to be successful in today's society. In traditional teaching, students are expected to receive the information instructed and repeat it at the examination given at the end of the process. In the process of receiving information, whether the student comprehends the information, internalizes it or memorizes it is not taken into account. In constructivist approach, on the other hand, students are expected to construct information by processing it cognitively. Laney (1990) states that the use

www.manaraa.com

of technology in constructivist approach is efficient in developing high-order thinking skills including identifying and solving problems as well as producing convenient solutions. In his study, Kaya (2008) found that interactive computer-supported teaching not only increased success but also improved high-order thinking skills and thus, enabled students to comprehend instead of memorizing. In addition, Renshaw and Taylor (2006) states that properly designed computer-supported teaching could affect some students' high-order cognitive skills positively. Similarly, Salomon (1996) indicates that using multi-media programmes makes it easier for learners to comprehend knowledge.

Supporting skills development

Gunes (2014b) indicates that developing skills rather than changing behaviors is among the modern developments of today's educational environment. With different programs on the computers, students are engaged in the different application and develop various skills. For instance, in order to develop problem-solving skills, students could be asked to collect data and find scientific information using computers. In addition, students could be given a problem; and then, those students who use a programming language at a good level could be asked to write program that solves the problem. Computer-controlled experiments can be used to develop experiment skills. With these software, student can determine variables, change certain features of these variables whilst computer can make the measurements for students, reflect the results of the changes in question, enable students to draw graphics of the results of the experiment via different software and to prepare experiment report. Word processing programs, which correct grammar mistakes and dictionary programs, can improve students' language skills and writing skills. Technology develop students' perspective to see things from different points of view or enable people to see things from the perspective of others by speaking to experts and asking them questions (Tezci and Gurol, 2001). Aedo et al. (2000) states that compared to traditional methods, computer-supported education develop problem solving and decision-making skills significantly. Bagci and Yalin's (2018) study is based on 5E learning model which is a model for using constructivist approach in education. According to the findings of the study, experimental groups had higher test scores than the control groups in academic achievement test. Moreover, it was found that experimental groups had higher retention test scores when compared to the control groups. In Simsir et al. (2018)'s research, students' achievements were analyzed with the developed laboratory activities for the General Chemistry Laboratory-II course. The developed laboratory activities were based on constructivist approach, enriched in terms of science process skills, to enable students actively participate and adopt the hypothesis based laboratory technique. As a result, it was found that there was a significant difference between experimental group and control group, academic achievement was in favour of the experimental group.

Arranging learning environments

In constructivist approach, which is based on the assumption that students construct their own knowledge by using scientific methods, the richness of the learning environment and students' own cognitive skills determine the construction of knowledge. Considering such opportunities of computer-supported education as bringing real-life into the classroom, offering such animations, which combine sound and image, its enriching effect is seen. What one can confer from this are that rich learning environments that will form the basis of real constructivist approach can be ensured via computer support.

Supporting activity-based learning

Gunes (2014b) claims that it is necessary to learn by discovering through activities in today's educational environments. In traditional learning environments, although there are different activities used, it is generally paper-based activities that are used. With technological tools, on the other hand, interactive activities supported with multimedia content such as sound, video and animations can be used.

Supporting the construction of a positive attitude towards learning

In many studies conducted, it is found that conducting the classes with a constructivist approach has positive impacts on students' attitudes towards the classes (Bilgin et al., 2013). In education, computer games are used in activities towards understanding a topic and making exercises. Students play games but at the same time learn the topic they should learn and have fun doing the exercises that are boring while on the book (Isik, 2010).

RECOMMENDATIONS

The results of the study reveal that technological tools support constructivist educational environments in many ways. Teachers' job is to use the limited resources in the most productive way, to know their students, organize the

www.manaraa.com

learning environments according to their individual characteristics, guide the students in the learning process, and to evaluate their learning. The methods used in traditional educational environments for all these activities bring a burden on teachers and since teachers have difficulties in this process, they cannot fulfill some of their responsibilities. Using technological tools in this process will make teachers' job easier.

Using technological tools will also support student learning, and make it easier to learn. It will enable identifying their individual differences, preparing convenient learning environments and evaluating them in the process. Considering all aforementioned in the light of the findings of the study, it is suggested to improve teachers' knowledge and skills of using technological tools, to provide technological equipment support in the classroom, and to support the use of technological tools in learning environments.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

REFERENCES

Adar N, Kandemir MC (2008). Avucici Cihazlar ve M-Öğrenme Araclari: M-Sinav ve M-Alistirma. 8th International Educational Technology Conference, Eskişehir, May 2008.

Aedo I, Díaz P, Fernández C, Martín GM, Berlanga A (2000). Assessing the Utility of an Interactive Electronic Book for Learning the PASCAL Programming Language. IEEE Transactions on Education 43(3):403-413.

Bagci KG (2001). Olusturmaci Fen Ogretimi. Kuram ve Uygulamada Egitim Bilimleri 1:9-22.

Bagci H, Yalin Hİ (2018). Harmanlanmis Ogrenme Ortaminda Denetim Odagina Gore Uyarlanmış 5E Ogrenme Modelinin Ogrencilerin Akademik Basarisina Etkisi. Kuramsal Egitimbilim Dergisi 11(3):562-585.

Balkan Kiyici F (2003). Fen Bilgisi Ogretiminde Olusturmaci Yaklasim Uygulamasinin Akademik Basariya Etkisinin Belirlenmesi. Sakarya University Journal of Education Faculty 7:151-162.

Baser VG, Mutlu N (2011). An Investigation of Relationship between Pre-Service Elementary Teachers' Pedagogical Beliefs and Their Technology Integration Perception. Paper presented at the Second International Conference on New Trends in Education and Their Implications, 27-29 April, 2011 Antalya-Turkey.

Becker HJ, Ravitz JL (2001). Computer Use by Teachers: Are Cuban's Predictions Correct? Paper presented at the 2001 Annual Meeting of the American Educational Research Association, Seattle, Washington.

Bilgin İ, Ay Y, Coskun H (2013). 5E Ogrenme Modelinin Ilkogretim 4. Sinif Ogrencilerinin Madde Konusundaki Basarilarina Etkisinin ve Model Hakkindaki Ogrenci Goruslerinin Incelenmesi. Kastamonu Egitim Dergisi 21(4):1449-1470.

Celikkaya T (2017). Sosyal Bilgiler Ogretiminde Arac-Gerec ve Materyal Kullaniminin Onemi. Sosya lBilgiler Ogretiminde Egitim Teknolojileri ve Materyal Tasarımı (2. Bs.), edited by Ramazan Sever and Erol Kocoglu 36-66. Ankara: PegemAkademi.

Ciglik H, Bayrak M (2015). Uzaktan Ogrenme ve Yapisalci Yaklasim. Istanbul Acik ve Uzaktan Egitim Dergisi 1(1):87-102.

Coppola EM (2004). Powering up: Learning to Teach Well with Technology. New York: Teachers College Press.

Ertmer PA (2005). Teacher Pedagogical Beliefs: The Final Frontier in Our Quest for Technology Integration?. Educational Technology Research and Development, 53(4):25-39.

Gilakjani AP, Leong LM, Ismail HN (2013). Teachers' Use of Technology and Constructivism. Modern Education and Computer Science 4:49-63.

Gunes F (2013). Turkce Ogretimi Yaklasimlar ve Modeller. Ankara: Pegem Akademi Puclishing.

Gunes F (2014a). "Egitim Yaklasimlari." In Egitim Bilimine Giris, edited by Gunes, F., 25-41. Ankara: Pegem Akademi Publishing.

Gunes F (2014b). Egitimde Temel Kavramlar ve Cagdas Yonelimler. In Egitim Bilimine Giris, edited by Gunes, F., 4-21. Ankara: Pegem Akademi Publishing.

Isik AD (2010). Bilisim Teknolojileri Dersi İcin Olusturmaci Yaklasim Dogrultusunda Hazirlanan Ogrenme Paketinin Etkileri. Unpublishing PhD Thesis. Dokuz Eylül University.

Isik AD (2014). Egitimde Okul ve Teknoloji. In Egitim Bilimine Giris, edited by Gunes, F., 158-180. Ankara: Pegem Akademi Publishing.

Judson EE (2006). How Teachers Integrate Technology and Their Beliefs About Learning: Is There a Connection? Journal of Technology and Teacher Education 14(3):581-597.

Kaleci F (2013). Farklı Ogrenme Stillerine Sahip Ortaogretim Ogrencilerinin E-Ogrenmeye Yonelik Tutumlarının Incelenmesi, Ulusal Uzaktan Egitim ve Teknolojileri Sempozyumu, Konya.

Kaya N (2008). Sosyal Bilgiler Ogretiminde İnteraktif (Etkileşimli) Bilgisayar Destekli Ogretimin Ogrenci Başarisina Etkisi. Unpublished Master Thesis. Yeditepe University.

Kılıç E, Karadeniz Ş, Karataş S (2003). İnternet Destekli Yapici Ogrenme Ortamlari. Gazi University Journal of Gazi Educational Faculty 23(2):149-160.

Koile K, Singer DA (2006). Development of a Tablet-PC-Based System to Increase Instructor-Student Classroom Interactions and Student Learning. In The Impact of Pen-based Technology on Education: Vignettes, Evaluations, and Future Directions, edited by Berque, D., Prey, J. and R. Reed. Purdue University Press pp. 115-122.

Laney D (1990). Micro Computers and Social Studies. OCSS Rewiev 26:30-37.

Moersch C (1999). Assessing Current Technology Use in the Classroom: A Key to Efficient Staff Development and Technology Planning. Leading and Learning with Technology 26(8):40-49.

Niederhauser DS, Stoddart T (2001). Teachers' Instructional Perspectives and Use of Educational Software. Teaching and Teacher Education 17:15-31.

Perkins D (1992). Smart Schools: From Training Memories to Educating Minds. New York: The Free Press.

Perkins D (1993). Teaching for Understanding. American Educator: The Professional Journal of the American Federation of Teachers 17(3):28-35.

Renshaw CE, Taylor HA (2006). The educational efectiveness of computer-based instruction. Computers and Geosciences 26:677-682.

Salomon G (1996). Technology's Promises and Dangers in a Psychological Context: Implications for Teaching and Teacher Education. Paper Presented at the Second International Conference on Teacher Education: Stability, Evolution and Revolution, Wingate Institute, Israel.

Siemens G (2005). Connectivism: A Learning Theory for the Digital Age. International Journal of Instructional Technology and Distance Learning (ITDL). http://er.dut.ac.za/handle/123456789/69. (19.06.2015).

Simsir N, Unal A, Yerlikaya Z (2018). Yapilandirmaci Yaklasim ve Bilimsel Surec Becerilerine Dayali Gelistirilen Laboratuvar Etkinliklerinin Ogrenci Basarisi Uzerine Etkisi. Kastamonu Education Journal 26(2):499-507.

TDK (2018). Guncel Turkce Sozluk. <http://www.tdk.gov.tr/index.php?option=com_gtsandarama=gtsandguid=TDK.GTS.52f78a2d1503f6.54743493> (12.10.2018).

Tezci E, Gurol A (2001). Olusturmaci Ogretim Tasariminda Teknolojinin Rolu. Sakarya University Journal of Education Faculty 3:151-156.

www.manaraa.com

Turgut MF, Baker D, Cunningham R, Piburn M (1997). Ilkogretim Fen Ogretimi. Ankara: Yok/Dunya Bankasi Milli Egitimi Gelistirme Projesi Hizmet Oncesi Ogretmen Egitimi.

Unal E, Cakir H (2016). Isbirlikli Teknolojilerle Desteklenen Yapilandirmaci Ogrenme Ortaminin Akademik Ugrasiya Etkisi. Journal of Instructional Technologies and Teacher Education 5(1):13-18.

Yavuz KG, Yanpar YT, Fakioglu B, Yıldız, İ (2013). Egitim Fakültesi Ogrenme Ortamlarinin Yapilandirmaci Anlayisa Uygunlugunun Degerlendirilmesi (Mersin Universitesi Ornegi). Journal of Qafqaz University- Philology and Pedagogy 1(2):216-227.

Yilmaz K, Naci S (2017). Teachers' perspectives on using smart boards and tablet pc in teaching. International Journal of Innovative Research in Education 4(1):17-27.

www.manaraa.com